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A Dental Assessment of the Dentoskeletal Prognathism in the North American Negro

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A DENTAL ASSESSMENT OF THE DENTOSKELETAL PROGNATHISM IN THE NORTH AMERICAN NEGRO

by

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ABOUT THE AUTHOR

Clarence Red was born in New Orleans, Louisiana.

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He then began his predental education at Loyola University, Chicago, Illinois, where he attended four years.

In 1961, he entered Loyola University School of Dentistry in Chicago, and was graduated in June, 1965. In the same year he began his graduate studies in oral biology in the orthodontic department at Loyola University.

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To my wife, I dedicate this effort.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

A. Introduction:

Prognathism is one of the common characteristics of the human face. It is a condition indicating the convexity of the face and it is common to certain ethnic types.

Facial prognathism is an ethnic characteristic of the Negro race. This thesis is concerned with a study of the degree of facial proganthism in Negro boys between the ages of twelve and sixteen. The tooth sizes, arrangement and arch form obtained from dental casts of American Negro boys will be studied.

B. Statement of the Problem:

To assess the dentoskeletal relationship of North American Negro children with normal class 1 occlusion.

CHAPTER II

REVIEW OF THE LITERATURE

Campers (1791) investigated prognathism craniometrically and from that time anthropologists have been interested in the ethnographic determination of facial form and pattern.

Prichard (1836), in writing of the physical peculiarities of the various groups of mankind said:

> "The third, or prognathous, corresponds to the Negro type . . . The cheek bones project rather forward than outward (prognathism)."

Talbot (1888) wrote:

> "The prognathism of the jaw increases with age of the individual. It is, however, sometimes a natural growth, as noticed in the Negro, and is characteristic of that race."

Oppenheim (1928) examined sixteen Negro skulls with normal occlusion and five having a class II, division I malocclusion. He concluded that in dental prognathism of the Negro the underdevelopment of the mandible leads to the incorrect assumption that the maxilla is over developed. He demonstrated that the relation found for the Eurasian skulls was true for the Negro skulls; the fixed points of the maxilla are not anterior, while the fixed points of the mandible are posterior.

Todd (1932), in a study on development of the face, concluded that in American Negroes, the forward pace of growth in the cranium and face is the same, but in whites, there is a tendency for facial extension to lag behind cranial.

Krogman (1934) studying certain dentofacial relationships assessed 355 adult skulls of different races.

He measured facial prognathism in the skull by relating the Frankfort Plane to two basilar diameters, basion to nasion and basion to prosthion. This is expressed as the Gnathic Index (Basi-alveolar x 100 divided by Base nasal length). The values derived by the Gnathic Index are classified: x-98, orthognathous; 98-103, mesognathous; 103-x, prognathous. Krogman concluded that Negroes in general are prognathous; Caucasoids, orthoganthous.

Hooton (1946) observed that the most marked forward protrusion of the jaws in modern groups is found among the Negroes and dark-skinned Australians. He found that among these races, the entire face juts out so that the tangent to the root of the nose and the most projecting part of the jaws form an acute angle with the forward prolongation of the Frankfort horizontal plane. Such markedly prognathous groups as the Negroes and Australians usually show a bulging of the alveolar regions of the upper and lower jaws which lodge the

front teeth.

Bjork (1947), using a sample of 600 Swedish boys, devised a facial diagram in which linear and angular measurements were used to determine facial prognathism. These measurements were assessed individually, in relation to one another, and as interrelated parts of the total facial diagram.

Bjork found that the nature of maxillary prognathism is derived from the shape and size of the cranial base, and shape of the facial skeleton. He showed that maxillary and mandibular prognathism usually occur simultaneously (total prognathism).

He stressed the fact that the facial profile is not determined by the amount of maxillary prognathism but by the relationship of the prognathism of the two jaws.

Cotton (1951) using the Downs analysis assessed variations in facial relationships of American Negroes. The sample in this study consisted of twenty individuals. He found the Negro more protrusive in both the denture and the facial skeleton.

Sassouni (1960) found that the molars occupy a similar position in the Caucasian and Negro. In Negroes, however, the incisors are more procumbent and the denture is more protrusive. Negroes have a steeper palate and, although the maxilla (ANS-PNS)

is the same size as in whites, the mandible is longer antero-posteriorly. The anterior lower face in Negroes is larger (ANS-ME) and they have a broader bizygomatic diameter and bicondylar width but a narrower bigonal width from the frontal view.

Altemus (1960) in a study of cephalofacial relationships of North American Negro children found that the degree and nature of the prognathism attributed to the Negro is a dental prognathism. The chin point as related to the facial plane is similar to that of the orthognathous face of the Caucasian.

CHAPTER III

METHODS AND MATERIALS

A. Selection of the sample:

Fifty young adult Negro males were selected for this study. These subjects were chosen on the basis of their excellent occlusions. Approximately two thousand North American Negro boys were examined in five youth centers. The examination was intraoral and extraoral. These children represented a cross-section of many income groups. A selection was made of children who were between twelve and sixteen years of age and who had permanent dentitions and had received no orthodontic treatment. Sixty subjects had excellent occlusions. From this group, fifty individuals were chosen meeting the following criteria:

1. Class I molar relation (Angle) on both right and left sides.
2. Symmetry of maxillary and mandibular arch.
3. Presence of all teeth except third molars.
4. Normal gingival condition and good oral hygiene.
5. No previous orthodontic treatment.
6. Absence of temporomandibular joint disturbances.
7. Broken contacts causing no more than 5 mm. of

crowding in the maxillary or mandibular arch.

8. Curve of spee not in excess of 3 mm. on either side.
9. Anterior overjet not in excess of 5 mm.
10. Anterior overbite not in excess of 5 mm.
11. Spacing not in excess of 5 mm. in either arch.
12. No teeth rotated over twenty degrees.

The subjects were in Hellman's dental age IV A; their permanent dentitions were complete except for the third molars. This group was selected because it was felt that they are representative of a very stable period in the growth and development of the head and face. Their dentitions are also stable; they are beyond the variability seen during the period of the mixed dentition and ahead of the possible influences of the third molars on the occlusion.

All the children with normal occlusion were invited to the orthodontic department for further study. These studies consisted of intraoral periapical radiographs, plaster casts, lateral cephalometric radiograph, and facial photographs.

Each subject was given a number which was subsequently used to identify his records. This provides an easy method for labeling and identifying the records and prevent a biased appraisal of the findings which might have resulted had the subjects name been used.

B. Collection of the material for investigation:

The area of investigation will be confined to the plaster casts. These plaster casts were made from impressions taken on the same sample used in the study by Roland Thomas.

Impression trays of the proper size were selected and beaded with Mortite. The subject rinsed his mouth with a silicone liguid to reduce the surface tension of the saliva in order to obtain an impression with a minimum of imperfections in it.

The impression of the maxillary and mandibular arches were taken so as to incorporate the surrounding alveolar process and soft tissue covering. Each impression was rinsed with cold water.

The impressions were poured in Kerr Snow White number 1 plaster which was mixed with water and spatulated in a vacuum spatulator (Whip-mix) until all air bubbles were removed and a smooth mixture was achieved.

After the plaster had set thoroughly the impression material and tray were removed from the casts. The casts were trimmed and finished.

C. Description of selected landmarks:

The configuration of the maxillary and mandibular dental arches, the arrangement of the teeth within their

respective arch, and the relationship of the dental arches to one another was determined for each subject from various measurements made on the plaster casts. The following measurements were made:

1. With respect to the individual jaw
   (a) Width of the dental arch--The width of the arch at the canines, the first premolars and the first molars, measured across the arch.
   (b) Length of the dental arch--The sum of the mesiodistal widths of all the teeth from distal of the left first molar to the distal of the right first molar.
   (c) Anterior width--The sum of the mesiodistal widths of canines, lateral incisors and central incisors.
   (d) Incisor width--The sum of the mesiodistal widths of the lateral incisors and central incisors.
   (e) Dental arch spacing--Both the number of spaces and the total space between mesial and distal of adjacent teeth.

(f) Rotations of dental units--The number of teeth rotated over five degrees and the total amount of arch length lost from rotations.

(g) Broken contact points caused by crowding--The number of broken contacts and total arch length accounted for by the broken contacts.

2. With respect to occlusion

(a) Overbite--The superior-inferior relationship of the incisal edge of the maxillary anteriors to the mandibular anteriors.

(b) Overjet--The antero-posterior relationship of the maxillary anteriors to the mandibular anteriors.

(c) Curve of Spee--The degree to which the occlusal platform varies from a flat plane.

(d) Maxillary first molar to mandibular first molar relationship--The mesiodistal relationship of the maxillary first molar to the mandibular first molar.

(e) Maxillary canine to mandibular canine relationship--The mesiodistal relationship of

the maxillary canine to the mandibular canine.

D. Methods of measurements:

The instruments used in the measurements of the plaster casts were: a millimeter scale calibrated to 0.5 mm.; vernier calipers calibrated to 0.1 mm.; celluloid protractor calibrated to 0.5 degrees; a pair of dividers; Korkhaus tri-dimensional calipers and a scalpel.

Prior to measuring the casts, a data sheet was designed so that information could be recorded in tabular form (Table 1). Readings were made by the principal investigator and recorded by an assistant.

The following is a description of the method employed for obtaining each measurement

1. With respect to the individual jaw

   (a) The width of the dental arch was measured with the Korkhaus tridimensional caliper at the canines, the first premolars and at the first molars. The measuring points were the tip of the cusp on the canines, the tip of the buccal cusp of the first premolars, and the tip of the mesial buccal cusp of the first molars. In cases where attrition had worn the cusp tip, the center of the

CASE # ____

TABLE 1

DATA SHEET - - CAST ANALYSIS

WITH RESPECT TO THE INDIVIDUAL JAW

1. INTERCANINE WIDTH
2. INTERPREMOLAR WIDTH
3. INTERMOLAR WIDTH
4. ARCH LENGTH MOLAR TO MOLAR
5. CANINE TO CANINE WIDTH
6. INCISOR WIDTH
7. NUMBER OF SPACES
8. SPACING, MILLIMETERS
9. NUMBER OF ROTATIONS
10. ROTATIONS, MILLIMETERS
11. NUMBER OF BROKEN CONTACT POINTS
12. BROKEN CONTACTS, MILLIMETERS

WITH RESPECT TO OCCLUSION

13. OVERBITE
14. OVERJET
15. CURVE OF SPEE
16. MAX. 6 TO MAND. 6 RELATION
17. MAX. 3 to MAND. 3 RELATION
18. MANDIBULAR ARCH DISCREPANCY
19. RATIO, MAX.; MAND. ARCH LENGTH
20. RATIO, MAX.; MAND. ANTERIOR WIDTH
21. RATIO, MAX.; MAND. INCISOR WIDTH

flattened area was taken as the measure point.

(b) The length of the dental arch was determined by measuring the mesio-distal width of both first molars, all four premolars, both canines and all four incisors in one arch. These measurements were taken individually using a pair of dividers. The width of each tooth was determined by adjusting the jaws of the dividers so that they measured the mesio-distal width of the tooth at the greatest convexity of the mesial and distal surfaces. The width of the teeth was first recorded on the data sheet by piercing the sheet directly on a horizontal line provided on the sheet with both pointers of the dividers. This method was followed for both arches using separate horizontal lines on the same data sheet to record the widths. The vernier caliper was used to measure the distance from the first pierced hole to the thirteenth pierced hole. This distance was recorded as the molar to molar arch length.

(c) The anterior width was determined by measuring

the mesio-distal width of the canines and incisors in one arch. These measurements were taken individually using a pair of dividers.

(d) The incisor width was determined by measuring the mesio-distal width of the four incisors in one arch. These measurements were also taken individually using a pair of dividers.

(e) The dental arch spaces were recorded and each space was measured with the vernier caliper. The total amount of space in one arch was recorded. The same procedure was followed for the opposing arch.

(f) The total number of teeth rotated more than five degrees was recorded for the maxillary and mandibular arch. The mesio-distal width of each tooth rotated over five degrees was measured with the dividers. The total mesio-distal width of the rotated teeth was then determined. The mesio-distal space occupied by the rotated teeth was recorded in the same manner. The difference between the total mesiodistal width of the teeth and the total

space occupied by them was then entered as the total number of millimeters accounted for by rotations. A separate entry was made for maxillary and mandibular rotations.

(g) Broken contact points caused by crowding was recorded. The mesio-distal width of each tooth displaced from normal alignment due to broken contact was measured with the dividers. The total mesio-distal width of such teeth was measured with the vernier calipers. The total space occupied in the arch by these same teeth was recorded and measured in the same manner. The arch length discrepancy was calculated as the difference in millimeters between total width of the teeth and total space occupied in the arch. This was done in both arches.

(h) The total arch length discrepancy was recorded. This figure represents the net amount of discrepancy in the arch caused by spacing, broken contacts, and rotations. A positive value denotes overspacing, and a negative value crowding.

(i) The total mandibular arch length discrepancy represents the net amount of discrepancy in the mandibular arch caused by spacing, rotations, and broken contacts. When the tooth measurement and the interdental spaces were greater than the size of a normal arch free from spaces, a positive entry was made. A negative entry was made when there was insufficient arch length available to accept the teeth in normal alignment.

2. With respect to occlusion

(a) The overbite was measured at the left central incisors. The maxillary and mandibular casts were placed in centric occlusion. The scalpel blade was held in contact with the incisal edges of the incisor and parallel to the occlusal plane. A fine horizontal scratch was made with the blade on the labial surface of the mandibular left central incisor. The overbite was then measured from the scratch mark to the incisal edge of the mandibular left central incisor.

(b) The overjet measurement was made with the

casts in occlusion. The measurement was taken from the scratch mark on the mandibular left central incisor to the incisal edge of the maxillary left central incisor by means of a narrow scale marked in 0.5 mm. In cases showing some attrition of maxillary incisal edge, the measurement was taken to the middle of the attritioned edge.

(c) The curve of Spee was measured by placing the protractor on the occlusal surfaces so as to make contact with the highest cusp of the first molar and the highest tooth in the anterior region of the arch. A millimeter scale was then used to measure the distance from the protractor to the tip of the cusp of the tooth most inferior to the protractor. This was recorded as the curve of Spee for the right side. The same was done on the left side.

(d) The maxillary first molar to mandibular first molar relationship was determined with the casts in centric occlusion. If the mesial buccal cusp of the maxillary molar fit

directly in the buccal groove of the mandibular first molar, a zero was entered on the data sheet. If this cusp did not fall directly in the groove, the distance from cusp to groove was measured in millimeters. If the cusp was distal to the groove, a negative value was recorded; if the maxillary molar cusp was mesial to the groove, a positive value was used. This was done on both sides of the casts.

(e) The maxillary canine to mandibular canine relationship was noted. If the maxillary canine cusp tip fit directly in the mandibular embrasure between the mandibular canine and first premolar the value was considered zero. If the maxillary tooth was distal to the embrasure, a negative value was recorded; if the maxillary canine was mesial to the embrasure, a positive entry was made on the data sheet. The same procedure was used on both sides.

(f) The ratio of the maxillary to mandibular arch length represents the total mesio-distal

width of the maxillary teeth from molar to molar, divided by the total mesio-distal width of the mandibular teeth from first molar to first molar.

(g) The ratio of the maxillary to mandibular anterior width was obtained by dividing the total mesio-distal width of the six maxillary anterior teeth by the total mesio-distal width of the six mandibular anterior teeth.

(h) The ratio of the maxillary to mandibular incisor width was obtained by dividing the total mesio-distal width of the four maxillary incisor teeth by the total mesio-distal width of the four mandibular incisor teeth.

CHAPTER IV

FINDINGS

The statistical analysis of the thirty-three measurements considered in this study can be found in Tables II and III. Table II shows the ranges for twenty of the measurements, the mean, standard deviation, and the 95% confidence limits for the range of each value (mean ± 1.96 x standard deviation). The remaining thirteen sets of measurements are shown in Table III with their corrected (real) values for the mean, standard deviation, and the 95% confidence limits. These calculations were necessary in order to present a true evaluation of the data. For example, the mean value for the number of mandibular broken contact points cannot be 1.22; the real value for this figure is one.

Maxillary and mandibular arch widths were measured in the canine, first premolar, and first molar regions on each set of casts. The results of these measurements are listed in Table II.

The mesio-distal widths of all the teeth from left first molar to right first molar in both arches were measured. The mean value for the total mesio-distal width of the twelve maxillary teeth was 99.69 mm. The mean value for the combined

TABLE II

Statistical Evaluation of Data

Measurement	Exp. Range	Mean	S.D.	95% Confidence Limits Low	High
Max. Intercanine Width	33.0 to 41.4	36.71	2.09	32.62	40.80
Mand. Intercanine Width	24.0 to 32.3	28.35	2.06	24.32	32.38
Max. Interpremolar Width	40.0 to 50.5	45.38	2.64	40.21	50.55
Mand. Interpremolar Width	32.6 to 41.7	36.71	2.22	32.36	41.06
Max. Intermolar Width	51.0 to 62.7	55.79	3.13	49.66	61.92
Mand. Intermolar Width	42.3 to 54.0	48.15	2.78	42.70	53.60
Max. Arch Length	92.7 to 113.6	99.69	4.79	90.32	109.06
Mand. Arch Length	81.8 to 103.4	91.59	4.31	83.14	100.04
Ratio max./mand. arch length	1.04 to 1.21	1.09	0.028	1.04	1.14
Width Max. Anteriors	44.8 to 56.1	48.92	2.43	44.16	53.68
Width Mand. Anteriors	34.1 to 46.5	38.57	2.44	33.79	43.35
Ratio Max./mand. Ant. Width	1.09 to 1.36	1.25	0.052	1.15	1.35
Width Max. Incisors	29.3 to 38.5	32.68	0.55	31.61	33.75
Width Mand. Incisors	20.8 to 27.4	23.81	1.35	21.16	26.46
Ratio Max./Mand. Incisors	1.19 to 1.50	1.37	0.047	1.28	1.46
Overbite	1.1 to 4.0	2.52	0.79	0.97	4.07
Overjet	1.0 to 5.0	3.17	0.98	1.25	5.09
Curve of Spee	0.0 to 2.5	0.90	0.62	-0.31	2.11
6/6 Relation	-2.0 to 2.5	-0.29	0.78	-1.82	1.24
3/3 Relation	-0.5 to 3.5	0.63	0.75	-0.84	2.10

TABLE III

Statistical Values and Real Values for
Factors Contributing to Arch Length Discrepancy

Measurements		Exp. Range	Mean	S.D.	95% Confidence Limits Low	High
Number of Max. Broken Contacts	Stat.	0 to 2	0.54	0.70	-0.83	1.91
	Real		1	1	0	2
Millimeter Max. Broken Contacts	Stat.	0 to 1.9	0.30	0.47	-0.62	1.22
	Real		0	0	0	1
Number of Mand. Broken Contacts	Stat.	0 to 5	1.22	1.15	-1.03	3.47
	Real		1	1	0	3
Millimeters Mand. Broken Contacts	Stat.	0 to 4.7	0.64	0.80	-0.93	2.21
	Real		1	1	0	2
Number of Max. Spaces	Stat.	0 to 5.0	2.00	1.71	-1.35	5.35
	Real		2	2	0	5
Millimeters Max. Spaces	Stat.	0 to 5.0	1.65	1.59	-1.46	4.76
	Real		2	2	0	5
Number of Mand. Spaces	Stat.	0 to 4	1.06	1.39	-1.66	3.78
	Real		1	1	0	4
Millimeters Mand. Spaces	Stat.	0 to 4.5	0.86	1.28	-1.65	3.37
	Real		1	1	0	3
Number of Max. Rotations	Stat.	0 to 2	0.12	0.43	-0.72	0.96
	Real		0	0	0	1
Millimeters Max. Rotations	Stat.	0 to 0.7	0.03	0.013	0.005	0.55
	Real		0	0	0	1
Number of Mand. Rotations	Stat.	0 to 2	0.46	0.064	0.33	0.59
	Real		0	0	0	1
Millimeters Mand. Rotations	Stat.	0 to 1.2	0.21	0.34	-0.46	0.88
	Real		0	0	0	1
Total Mand. Arch Length Discrepancy	Stat.	-4.7 to 4.5	0.02	1.75	-0.019	0.059
	Real		0	2	0	0

widths of the mandibular teeth was 91.59 mm. For each set of casts, the width of the twelve maxillary teeth was divided by the widths of the twelve mandibular teeth. This ratio of the maxillary to mandibular teeth was determined for each subject. The experimental range for this ratio was 1.04 to 1.21. The mean value was 1.09. Because all of the subjects in this study had normal occlusions, the ratio of maxillary to mandibular arch length can be taken as normal.

The combined mesio-distal widths of the six anterior teeth were recorded for each arch on all sets of casts. The mean value for the total mesio-distal width of the six maxillary anterior teeth was 48.92 mm. The mean value for the combined widths of the mandibular teeth was 38.57 mm. The total maxillary anterior width was divided by the total mandibular anterior width in order to determine an anterior ratio. The mean value for this ratio was 1.25. This ratio indicates the normal tooth size relationship between the maxillary and mandibular six anterior teeth. Using the anterior ratio in conjunction with the total arch length ratio, one can determine if a tooth size discrepancy exists between the two arches, and whether this discrepancy in tooth size prevails in the anterior or posterior teeth.

The mesio-distal widths of the four incisor teeth were recorded for each arch on all sets of casts. The mean value for the maxillary incisors was 32.68 mm. The mean value for the combined widths of the mandibular incisor teeth was 23.81 mm. A ratio of maxillary to mandibular incisors was established. The combined widths of the maxillary incisors was divided by the combined widths of the mandibular incisors for each case. The mean value was 1.37. This ratio will aid in deciding exactly where a tooth size discrepancy occurs in the anterior region.

One of the criteria fulfilled by all the subjects selected for this study was an allowable anterior overbite of five millimeters or less. The experimental range for this measurement was 1.10 mm. to 4.0 mm. The mean value was 2.52 mm.

The maximum allowable limit of anterior overjet for those qualifying for this study was 5.0 mm. Five subjects had this amount of overjet. The experimental range for this measurement was 1.0 mm. to 5.0 mm. The mean value was 3.17 mm.

The depth of the curve of spee was measured on the right and left sides of all mandibular casts. Seven of the subjects had a perfectly flat occlusal plane. The experimental range was from zero or flat occlusal plane to 2.5 mm. deep. The mean value was 0.90 mm.

All cases selected for this study had a class I (Angle) molar relationship bilaterally. Each set of casts was examined for exact interdigitation of the mesial-buccal cusp of the maxillary first molar with the buccal groove of the mandibular first molar. Twenty of the casts showed ideal interdigitation on both right and left side. In eight of the casts one side was in ideal interdigitation while the other had the maxillary molar slightly anterior. In six cases there was an ideal interdigitation on one side, while the maxillary molar was slightly posterior to the buccal groove of the mandibular molar on the opposite side. In one case the mesiobuccal cusps of both maxillary molars were slightly anterior to the buccal groove of the mandibular molars. In thirteen cases the maxillary molar on both sides were slightly posterior. In one case the maxillary molar on one side was slightly posterior, and the maxillary molar on the opposite side slightly anterior.

The experimental range for this measurement was 2.0 mm. posterior, to 2.5 mm. anterior (mean 0.29 mm. posterior). The slight deviations from normal Class I molar relationship were not of sufficient magnitude to disqualify a case from a classification of normal occlusion. In those cases showing some deviation in the molar relationship, the premolars were

in perfect interdigitation, indicating that mesial drift of the buccal segments was not the cause of the molar variation.

Each case was examined in centric occlusion to determine the relation of the maxillary canine to the embrasure between the mandibular first premolar and canine. In fourteen cases the tip of both maxillary canine cusps was correctly related to the mandibular embrasure between the first premolar and canine. In thirteen of the subjects the relationship on one side was ideal while the cusp tip was slightly anterior to the embrasure on the other. Twenty-two cases had the cusp tips anterior to their respective embrasure on both sides of the arch. In one case the maxillary canine cusp tip on one side was mesial to the mandibular embrasure and the maxillary canine on the other side was distal to the mandibular embrasure.

In all cases where the maxillary canines were forward, the premolar occlusal relationship was normal, indicating that mesial drift of the maxillary buccal units did not cause the forward position of the canines. The mesial positioning of the molars and canines was caused by the size difference between maxillary and mandibular teeth.

The experimental range, mean, standard deviation and 95% confidence limits for all the dental factors which

contribute to arch length discrepancy in this study are shown in Table III. Statistical values as well as real values are listed. The statistical data were considered to be confusing in certain instances, and therefore corrections of these data were made and charted as real values. The real value appears directly below the statistical finding for each entry.

The allowable crowding, caused by broken contact points, was limited to a maximum of 5.0 mm. in either arch. Allowable spacing was also 5.0 mm. in either arch. No case having teeth rotated over five degrees was used in this sample. All of these limiting factors contributed to an experimental range of -4.7 mm. to 4.5 mm. for total mandibular arch length discrepancy in this investigation. The mean figure for mandibular arch length discrepancy was 0.02 mm.

Twenty-six cases showed spacing or open contacts in the maxillary arch. Twenty-one cases had broken contacts due to crowding in the maxillary arch.

Thirty-three subjects had broken contact points and crowding in the mandibular arch, indicating there was more tooth material than the arch would accommodate. The experimental range was from 0 to 4.7 mm. The mean figure was 0.64 mm.

With the exception of total Mandibular Arch Length Discrepancy all of those statistical findings in the low 95%

confidence column which show a negative or minus value are incorrect. Each measurement was taken separately and positive values, which either increased or decreased the total amount of arch length discrepancy, were entered on the data sheet. Therefore the value for total Millimeters Broken Contact, or the Total Millimeters of space available in the arch was always zero or greater than zero. Corrections have been made to indicate that the low limit for each such measurement is zero.

For each entry of factors contributing to arch length discrepancy the statistical values (fractional numbers) have been corrected to the practical (real) whole numbers. As an example: Number of Maxillary Broken Contacts is seen to have a statistical standard deviation of 0.70, and a real standard deviation of one; the statistical evaluation of high and low 95% confidence limits show 1.91, and -0.83 respectively; the real values for these two latter figures are 2, and 0, respectively.

Any rotated tooth causing a broken contact point was considered to be contributing to arch length discrepancy. Therefore, even though such a tooth was counted in the total number of rotations, its value in the assessment of total arch length discrepancy was as a tooth having a broken contact

point due to crowding.

Twenty-three cases showed rotation of one or more teeth in the maxillary arch. Rotation of one or more mandibular teeth was observed in thirty-nine of the subjects. Three of the cases presented one or more rotations in both arches. No candidate had more than five rotated teeth in either arch.

CHAPTER V

DISCUSSION

An important consideration in the diagnosis and subsequent treatment planning in clinical orthodontics is an understanding of the normal relationship between the facial profile and denture. Data published for one racial group are often used in planning treatment of other racial groups. There are obvious differences in the configurations of the faces of these groups.

Prognathism is one of the common characteristics of the human face. The degree of prognathism of the various parts of the face varies in different races. This investigation was designed to determine tooth sizes, arrangement and arch form of the American Negro child.

Young adults were chosen for this study because their arch form and tooth arrangement is determined and should remain relatively stable.

The dentitions of the subjects used in this investigation conformed to requirements in the chapter on methods and materials. Properly articulated plaster models of each subject were constructed. Measurements were taken from certain landmarks on each set of casts in order to determine

the similarity and variability of the values for each landmark within the population.

Mean values were calculated for each measurement. Because of individual variation within the species, no denture can be expected to comply with all, or indeed any, of the mean values determined here. However, a range for each measurement was established as a framework within which a value can vary and still remain an acceptable normal value.

The term normal occlusion implies the existence of a molar relationship consistent with an anterior overjet of two or three millimeters, assuming there is good alignment of the teeth in both arches. It follows then, that a Class I (Angle) molar relationship must be obtained on both sides of the arch if the relationship of the maxillary and mandibular anterior teeth is to be esthetically and functionally correct. All of the cases in this study had the first molars in neutrocclusion.

The width across the arch in the canine, premolar, and molar regions was determined. The mean maxillary interpremolar width was 45.38 mm., with a range of 40.0 - 50.5 mm. The mean mandibular interpremolar width was 36.71 mm., with a range of 32.6 - 41.7 mm. Howes (1954) studied arch form,

tooth size and tooth arrangement of North American Caucasian children. The interpremolar width for Howes group measured from 39 - 45 mm. in the maxillary arch, with a mean of 41.3 mm., and from 31 - 37.5 mm. in the mandibular arch, with a mean of 33.9 mm. The width across the arch in the first premolar area is greater in this group as compared with the Howes group. Howes said: "The coronal arch width in the maxillary first bicuspid region should be at least 43 percent of the total maxillary tooth material from first molar to first molar inclusive." The percentage relationship of tooth material to interpremolar arch width was 45.5 percent for the Howes group and this group. This is surprising to note, especially when the tooth and arch sizes are larger for this group. The denture is further forward anterio-posteriorly in the North American Negro when compared to the North American Caucasian.

It was suspected by the author, that a direct relationship between the width of the arch in the premolar and molar regions and the total mesiodistal width of the four incisors would exist in any given case; as the numerical value of arch width increased or decreased, the tooth size would fluctuate in a proportionate manner. Previous findings by Pont (1909) which upheld the aforementioned theory could not

be substantiated by a statistical evaluation of measurements compiled for this study.

The total mesiodistal width of the maxillary and mandibular teeth from left first molar to right first molar was determined for each case. The mean total amount of maxillary tooth material was 99.69 mm., with a range of 92.7 - 113.6 mm. The mean total amount of mandibular tooth material was 91.59 mm., with a range of 81.8 - 103.4 mm. Howes study of North American Caucasian children showed that the maxillary arch length ranged from 85.0 - 98 mm., with a mean average of 91.7. The mandibular arch range was 78.5 - 89 mm., with a mean average of 84.1 mm. The mesiodistal diameters of the teeth are definitely larger for the North American Negro child. A similar observation was made by Altemus (1960) in his study of casts of Negro children with excellent occlusion.

The total mesiodistal width of the maxillary teeth was divided by the total mesiodistal width of the mandibular teeth to determine the total arch length ratio. This was done for each case. The mean value for this ratio was 1.09. Tooth size discrepancy between the mandibular and maxillary teeth can be determined with the aid of the total arch length ratio. There is no tooth size discrepancy if the value for this ratio is 1.09. The tooth material in the mandibular

arch is greater than average for the amount of tooth material in the maxillary arch if the ratio is less than 1.09. The tooth material is excessive in the maxillary arch if the ratio is greater than 1.09. Bolton (1958), in his study of disharmony in tooth size, divided the mandibular arch length by maxillary arch length and multiplied the ratio by 100. The mean figure for the ratio stated as a percent was 91.3. The Bolton value must be mathematically changed in order to compare it to that determined in this study. The change is as follows:

$$100/91.3 = 1.09$$

The ratio in both studies are the same. There is a proportionate increase in the mesiodistal width of the maxillary and mandibular teeth of the Negro child.

The left-hand column of Table IV lists twenty-six possible maxillary arch lengths ranging from 90 - 115 mm. The mandibular arch length which corresponds to the 1.09 ratio is listed in the right-hand column, opposite the appropriate maxillary value.

The method of using this chart was suggested by Bolton (1958) and later Thomas (1966). One would first compute the total arch length ratio for a given patient. If the ratio were greater than 1.09, he would then locate on the chart the

TABLE IV

Arch Length Ratio

$$\frac{\text{Mesiodistal Width of 12 Max. Teeth}}{\text{Mesiodistal Width of 12 Mand. Teeth}} = \text{Arch Length Ratio}$$

Mean Ratio = 1.09; Std. Dev. = 0.03; Exp. Range = 1.04 to 1.21

MAX. 12 (mm)	MAND. 12 (mm)	MAX. 12 (mm)	MAND. 12 (mm)
90	82.5	103	94.5
91	83.5	104	95.4
92	84.4	105	96.3
93	85.3	106	97.2
94	86.2	107	98.1
95	87.1	108	99.1
96	88.1	109	100.0
97	88.9	110	100.9
98	89.9	111	101.8
99	90.8	112	102.7
100	91.7	113	103.7
101	92.7	114	104.5
102	93.5	115	105.5

mandibular reading which corresponds to that of the patient. Opposite this he would find the correct value for the maxillary arch length. By subtracting this value from the value obtained from the patient, the amount of excess tooth material in the maxillary arch could be determined. If the ratio were less than 1.09, one would consult the chart for the value corresponding to the maxillary measurement for the patient. The mandibular value listed to the right of this measurement would then be subracted from the mandibular reading to determine the amount of excess tooth material contained in the lower arch.

As a further aid in the determination of tooth size discrepancy between the maxillary and mandibular arch, an anterior ratio was formulated according to Bolton (1958) and Thomas (1966). This was done by dividing the total mesiodistal width of the maxillary six anterior teeth by the total mesiodistal width of the mandibular six anterior teeth. The mean value for this ratio was 1.25. By ascertaining the anterior ratio for a case, the existence of a tooth size discrepancy in the anterior region can be discovered. This can be of particular value where a tooth size differential between the upper and lower teeth is suspected. In cases where discrepancy has been found through the use of the total

arch length ratio, the anterior ratio will indicate whether the size discrepancy is in the anterior or posterior teeth.

Table V lists various maxillary anterior widths and the appropriate mandibular anterior widths which correspond to the 1.25 ratio. The use of this table follows the same format as the use of Table IV as directed above.

The incisor ratio will pinpoint the oversized teeth in case of anterior tooth size discrepancy. The total mesiodistal width of the maxillary central and lateral incisors was divided by the total mesiodistal width of the mandibular central and lateral incisors. The mean value for this ratio was 1.37. If an anterior tooth size discrepancy exists, as determined by the anterior ratio, the incisor ratio will indicate whether the discrepancy is in the incisor teeth or the canines. If the anterior ratio shows a discrepancy, and the incisor ratio shows an equal discrepancy, the incisors are the offending teeth. However, if the anterior ratio indicates a discrepancy and the incisor ratio is normal, the discrepancy is in canine tooth size.

Tooth size discrepancies in the anterior region can cause undesirable esthetic results in a treated case. If the mandibular anterior tooth size ratio is larger for the size of the maxillary anteriors, the finished result will of

TABLE V

ANTERIOR RATIO

$$\frac{\text{Mesiodistal Width of Max. 6 Anteriors}}{\text{Mesiodistal Width of Mand. 6 Anteriors}} = \text{Anterior Ratio}$$

Mean Ratio = 1.25; Std. Dev. = 0.05; Exp. Range = 1.09 to 1.36

MAX. 6 (mm)	MAND. 6 (mm)	MAX. 6 (mm)	MAND. 6 (mm)
42.0	33.6	50.5	40.4
43.0	34.4	51.0	40.8
44.0	35.2	51.5	41.2
44.5	35.6	52.0	41.6
45.0	36.0	52.5	42.0
46.0	36.8	53.0	42.4
47.0	37.6	54.0	43.2
47.5	38.0	55.0	44.0
48.0	38.4	55.5	44.4
48.5	38.8	56.0	44.8
49.0	39.2	56.5	45.2
49.5	39.6	57.0	45.6
50.0	40.0	58.0	46.4

necessity show maxillary anterior spacing and good mandibular arch alignment. If the spaces in the maxillary arch are closed orthodontically, broken contact points will develop in the mandibular arch. The solution to such a problem lies in the determination of the tooth size differential, and subsequent stripping of the contacts of the mandibular anterior teeth. Through the use of the anterior ratio and the incisor ratio, one can determine the exact amount of stripping that will be necessary, and which teeth should be stripped.

If the tooth size differential of the maxillary anterior teeth is proportionally larger than that of the mandibular anterior teeth, increased overjet is the result, assuming the teeth in both arches are in good alignment. The alternatives are, spacing in the lower arch, or broken contact points caused by crowding of teeth in the upper arch, either of which will tend to solve the overjet problem. Stripping of the interproximal contact points in the maxillary arch can result in good arch alignment and desirable overjet relationship.

Table VI lists a range of upper incisor widths and corresponding lower incisor widths determined by the 1.37 ratio. Use of this table is identical to that described for Table IV.

TABLE VI

INCISOR RATIO

$$\frac{\text{Mesiodistal Width of Max. 4 Incisors}}{\text{Mesiodistal Width of Mand. 4 Incisors}} = \text{Incisor Ratio}$$

Mean Ratio = 1.37; Std. Dev. = 0.04; Exp. Range = 1.19 to 1.50

MAX. 4 (mm)	MAND. 4 (mm)	MAX. 4 (mm)	MAND. 4 (mm)
27.0	19.7	34.0	24.8
27.5	20.1	34.5	25.1
28.0	20.4	35.0	25.5
28.5	20.8	35.5	25.9
29.0	21.1	36.0	26.3
29.5	21.5	36.5	26.6
30.0	21.9	37.0	27.0
30.5	22.3	37.5	27.3
31.0	22.6	38.0	27.7
31.5	22.9	38.5	28.1
32.0	23.3	39.0	28.5
32.5	23.7	39.5	28.8
33.0	24.1	40.0	29.1

Table VII presents a composite of Tables IV, V and VI. It is felt that this index can be an aid to the clinical orthodontist in the analysis of tooth material in malocclusions found in Negro boys. The adverse effects of tooth size discrepancy such as recurring broken contact points can best be alleviated if the pressure of a discrepancy is discovered in the original analysis of the plaster casts.

The mean value for anterior overbite in this study was 2.52 mm. with a range of 1.1 - 4.0 mm. Steadman (1949), in a study of overbite relationships on patients with good occlusions, concluded that there was no one value of overbite that was standard or necessary for all good occlusions. He found a variation of 3.8 mm. between the low and high values for the anterior overbite.

A significant coefficient of correlation could not be found when the degree of overbite was related to the anterior ratio. Steadman (1949) and Bolton (1958) found this to be true.

The mean value for anterior overjet in this study was 3.17 mm. A minimal amount of overjet can be observed clinically, when the canine teeth are in a Class I relationship and all the anterior teeth in both arches are in tight contact. Changes in overjet are seen in malocclusions where

TABLE VII

Index for Determining Tooth Size Discrepancies in Negro Boys

ARCH LENGTH (mm)		ANTERIOR WIDTH (mm)		INCISOR WIDTH (mm)	
Max. 12	Mand. 12	Max. 6	Mand. 6	Max. 4	Mand. 4
90	82.5	42.0	33.6	27.0	19.7
91	83.5	43.0	34.4	27.5	20.1
92	84.4	44.0	35.2	28.0	20.4
93	85.3	44.5	35.6	28.5	20.8
94	86.2	45.0	36.0	29.0	21.1
95	87.1	46.0	36.8	29.5	21.5
96	88.1	47.0	37.6	30.0	21.9
97	88.9	47.5	38.0	30.5	22.3
98	89.9	48.0	38.4	31.0	22.6
99	90.8	48.5	38.8	31.5	22.9
100	91.7	49.0	39.2	32.0	23.3
101	92.7	49.5	39.6	32.5	23.7
102	93.5	50.0	40.0	33.0	24.1
103	94.5	50.5	40.4	34.0	24.8
104	95.4	51.0	40.8	34.5	25.1
105	96.3	51.5	41.2	35.0	25.5
106	97.2	52.0	41.6	35.5	25.9
107	98.1	52.5	42.0	36.0	26.3
108	99.1	53.0	42.4	36.5	26.6
109	100.0	54.0	43.2	37.0	27.0
110	100.9	55.0	44.0	37.5	27.3
111	101.8	55.5	44.4	38.0	27.7
112	102.7	56.0	44.8	38.5	28.1
113	103.7	56.5	45.2	39.0	28.5
114	104.5	57.0	45.6	39.5	28.8
115	105.5	58.0	46.4	40.0	29.1

there are skeletal differences in the relationship between upper and lower jaws, or where some local factors affect the teeth in the dental arches. Several arrangements of the anterior teeth can prevent the attainment of a good overjet condition even though the canines are in a Class I relationship. There may be spacing of the maxillary anterior teeth, tooth mass discrepancy between maxillary and mandibular anterior teeth, and broken contact points caused by a crowding of the mandibular anterior teeth.

The relation of the maxillary canine to the embrasure between the mandibular canine and first premolar was examined in each case. This inter-relationship is generally found when the molar teeth are in a neutrocclusion and where there is a normal tooth alignment of the remaining teeth. The majority of cases in this study had maxillary canines slightly forward of the proper mandibular embrasure. There was no correlation between mesially positioned canines and increased anterior overjet.

The method used to measure the relationship of the maxillary canine may account for the apparent forward position of this tooth in the majority of the cases. The tip of the maxillary canine cusp was used as a point of reference. If the tip of the cusp was forward to the mandibular embrasure,

the canine was considered to be forward. It was observed that, although the measurements indicate mesial positioning of most of the maxillary canines in this study, these teeth are not forward bodily, but they were inclined mesially so that the cusp tip was mesial to the embrasure.

The position of the mesial-buccal cusp of the maxillary molar teeth in centric occlusion was examined on each set of casts. This cusp was found to intercuspate precisely in the buccal groove of the mandibular first molar in forty percent of the cases. The maxillary cusp was slightly distal to the mandibular buccal groove in twenty-six percent of the cases. These small variations in the molar relationship had no effect on the centric relationship of the premolar teeth or the canines, and did not influence the anterior overjet relationship.

The maxillary second premolar interdigitated in the embrasure between the mandibular first molar and second premolar, and the maxillary first premolar interdigitated in the embrasure between the mandibular second premolar and first premolar. In nearly every case the buccal cusps of the maxillary premolars related correctly to their respective mandibular embrasures.

Mandibular arch length discrepancy causing minor broken contact points was a common characteristic in nearly all of the subjects in this study. Broken contact points between the mandibular anterior teeth were seen in sixty-six percent of the cases. The mean value for mandibular arch length discrepancy was 0.02 mm., with a range of minus 4.7 - 4.5 mm.

An important part of treatment planning in clinical orthodontics is an understanding of what is normal. An infinite variety of facial types may be found in any particular racial group due to inbreeding, yet these fall in a range that can be called normal. An important part of orthodontic treatment consists of changing certain facial features to improve them, especially in the denture area of the face. The present day orthodontist does not try to fit all of the facial and denture characteristics of his patients into a single mold, in fact he has found this is impossible. Instead he seeks to reach the optimum esthetic result consistent with good function and facial harmony. We have attempted to supply him with some of the knowledge necessary to assist in his decisions as to what is optimum for North American Negro children.

The data compiled in this study provides a means for establishing inter-relationships between measurements on the

casts and measurements obtained from the cephalogram of each subject. The standard (mean) values for each landmark and their statistical and experimental ranges have been recorded in a compact form for easy assessment by the orthodontist.

This study, along with the investigation by Roland Thomas, provides some material for the construction of an orthodontic diagnosis. The values obtained in the two studies are recorded as standards for one segment of the population.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study was undertaken to determine the dental characteristic of the North American Negro males with normal occlusion. The purpose of such a determination was to establish a criterion for normal occlusion which can be used by the clinical orthodontist in diagnosis and treatment planning. Two thousand subjects were examined before a final sample of fifty was selected to participate in this investigation. These participants fulfilled certain requirements with regard to morphology and function of the craniofacio-dental complex, as set forth in this experiment.

Thirty-three dental landmarks were selected as points from which measurements of diagnostic value and clinical interest were taken. The configuration of the dental arches, the position and size of the teeth within the arches, and the relation of the dental arches to each other was studied and evaluated. The values obtained from the measurements were considered to represent standards describing normal occlusion by virtue of the design of the experiment.

Evaluation of certain of the data furnished methods for determining the existence of size discrepancies between

teeth in opposing dental arches.

From statistical analyses of the data, the following conclusions were made:

1. The range of normal variability in tooth size within this group is very great, and because of this we wish to strongly emphasize the concept of the individual normal with modification indicated by racial attributes.
2. A significant coefficient of correlation could not be found when the mesiodistal width of the anterior teeth was related to the posterior width across the arch.
3. The mean sizes of the teeth are definitely larger for North American Negro children than for North American Caucasian children.
4. The maxillary and mandibular dental units can be divided so as to give normal ratios which can be compared one with another. This procedure can be an aid in localizing tooth size disharmonies which would alter the occlusal relationships desired from orthodontic treatment.
5. Variations from ideal were found in the entire sample.

6. Overbite within the range of 1.0 mm., to 4.0 mm., should be considered normal.
7. Anterior overjet within the range of 1.0 mm., to 5.0 mm., should be considered normal.
8. The depth of the curve of Spee should not exceed 2.5 mm. at its deepest point in normally occluding teeth.
9. A small amount of arch length discrepancy should be considered normal.
10. A significant coefficient of correlation could not be found when the degree of overbite was related to the anterior ratio.
11. The difference in tooth and arch size suggest that methods of orthodontic diagnosis and treatment planning for North American Caucasian children need some modification when used for North American Negro children.

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APPROVAL SHEET

The thesis submitted by Dr. Clarence J. Red, Jr. has been read and approved by members of the Department of Oral Biology.

The final copies have been examined by the Director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Science.

May 19- 1967
Date

Joseph R Jarabak
Signature of Adviser